Reinforced Concrete Box Culvert Design Caltrans

This revision of the ASCE Standard Practice for Direct Design of Buried Precast Concrete Pipe Using Standard Installations (SIDD) is a replacement of ANSI/ASCE 15-93. This Standard focuses on the direct design of buried precast concrete pipe using Standard Installations, and reviews the design and construction of the soil/pipe interaction system that is used for the conveyance of sewage, industrial wastes, storm water, and drainage. To account for the interaction between pipe and soil envelope when determining loads, pressure distributions, moment, thrust and shear, this volume presents the SIDD method for buried precast concrete pipe. Excavation, safety, foundation, bedding, sheathing removal and trench shield advancement are among those construction requirements for precast concrete pipe designed by the SIDD method that are presented here. This standard practice may be used as a reference in preparing project specifications based on the SIDD method. Four types of standard embankment installations and four types of standard trench installations are covered in the standard. The limits state design procedure specified for the design of pipe is consistent with the procedures outlined in the AASHTO Standard Specifications for Highway Bridges. The commentary provides supporting background data.

The study presents an evaluation of the deterioration of reinforced concrete 3-sided culverts and reinforced concrete box culverts in Ohio. The Office of Structural Engineering (OSE) database for bridge size culverts (structures with a span length of 10 ft. or greater along roadway centerline) was provided to by Ohio Department of Transportation (ODOT). The database included a record based on culvert inspection data, such as general appraisal and overall culvert condition ratings. Using the provided data, Markovian deterioration models and Weibull survival analysis models were developed for cast-in-place and precast reinforced concrete 3-sided and reinforced concrete box culverts. The major findings of the study are: Data preprocessing and quality assurance should be planned and coordinated properly with a systematic procedure outlined to limit data manipulation; Markovian models can be modified to model non-standard transitions, which were encountered in the data, such as condition rating improvement and two condition ratings drop in one year; On average, cast-in-place culverts deteriorate slightly faster up to the half of the design life and maintain a slightly higher condition rating near the end of the design life compared to precast 3-sided and box culverts; On average, cast-in-place box culverts maintain a slightly higher condition rating throughout their design life compared to 3-sided cast-in-place culverts; Precast 3-sided and box culverts have a similar deterioration trend on average; The Weibull survival analysis can be highly sensitive to censored to uncensored data ratio and extreme values.

Seismic Analysis and Design of Retaining Walls, Buried Structures, Slopes, and Embankments

Development of Design Criteria for Reinforced Concrete Box Culverts. Part I: Strength and Behavior of Reinforced Concrete Beams and Frames

Modernize and Upgrade CANDE for Analysis and LRFD Design of Buried Structures

Concrete Pipe and the Soil-structure System

Engineers' Pocketbook of Reinforced Concrete

The results of 57 tests on simply-supported beams and 24 tests on frame members are described and correlated in this report. The main object of these tests was to study the behavior and strength in shear of reinforced concrete members; a few tests were intended to study the flexural strength of under-reinforced members under axial load and bending. The ultimate objective of the test program was to obtain information which would permit the development of more rational design criteria for reinforced concrete box culverts. Fundamental knowledge was first acquired through tests of simplysupported beams under various conditions of loading. And, finally, tests were made on 24 frames under conditions simulating closely those in the horizontal member of a box culvert section; three of these frames had web reinfrocement in the form of bent bars. The following major variables were studied during the course of the investigation: type of loading, concrete strength, steel percentage, ratio of span length to effective depth, ratio of shear span to effective depth, and ratio of axial to vertical load. The simply-supported beams were tested under one or two concentrated loads, or under uniform load.

Concrete box culvert floor slabs are known to have detrimental effects on river and stream hydraulics. Consequences include an aquatic environment less friendly to the passage of fish and other organisms. This has prompted environmental regulations restricting construction of traditional, four-sided box culvert structures in rivers and streams populated by protected species. The box culvert standard currently used by the Kansas Department of Transportation (KDOT) is likely to receive increased scrutiny from federal and state environmental regulators in the near future. Additionally, multiple-cell box culverts present a maintenance challenge, since passing driftwood and debris are frequently caught in the barrels and around cell walls. As more structures reach the end of their design lives, new solutions must be developed to facilitate a more suitable replacement. Since construction can cause significant delays to the traveling public, systems and techniques that accelerate the construction process should also be considered. This report documents development of a single-span replacement system for box culverts in the state of Kansas. Solutions were found using either a flat slab or the center span of the KDOT three-span, haunched-slab bridge standard. In both cases, the concrete superstructure is connected monolithically with a set of abutment walls, which sit on piling. The system provides an undisturbed, natural channel bottom, satisfying environmental regulations. Important structural, construction, maintenance, and economic criteria considered during the planning stages of bridge design are discussed. While both superstructural systems were found to perform acceptably, the haunched section was chosen for preliminary design. Rationale for selection of this system is explained. Structural modeling, analysis, and design data are presented to demonstrate viability of the system for spans ranging from 32 to 72 feet. The new system is expected to meet KDOT's needs for structural, environmental, and hydraulic performance, as well as long-term durability. Another option involving accelerated bridge construction (ABC) practices is discussed.

Fibre-reinforced Plastics for Reinforced Concrete Structures : Proceedings of the Fifth International Conference on Fibre-Reinforced Plastics for Reinforced Concrete Structures, Cambridge, UK, 16-18 July 2001

Draft of Final Report, Precast Box Culvert Study

Reinforced Concrete Culvert Pipe

Debris-control Structures

Design and Proof Test Requirements for Precast Reinforced Concrete Box Culverts

Timely, authoritative, extremely practical--an exhaustive guide tothe nontheoretical aspects of bridge planning and design. This bookaddresses virtually all practical problems associated with theplanning and design of steel and concrete bridge superstructuresand substructures. Drawing on its author's nearly half-century as abridge designer and engineer, it offers in-depth coverage of suchcrucial considerations as selecting the optimum location andlayout, traffic flow, aesthetics, design, analysis, construction,current codes and government regulations, maintenance andrehabilitation, and much more. * Offers in-depth coverage of all the steps involved in performingproper planning and design with comparative analyses of alternativesolutions * Includes numerous examples and case studies of existing bridgesand important projects underway around the world * Features a time-line history of bridge building from pre-Romantimes to the present * Summarizes key technical data essential to bridgeengineering * Supplemented with 200 line drawings and photos vividlyillustrating all concepts presented * Comprehensive coverage of CAD planning, design, and analysistechniques and technologies

This report explores analytical and design methods for the seismic design of retaining walls, buried structures, slopes, and embankments. The Final Report is organized into two volumes. NCHRP Report 611 is Volume 1 of this study. Volume 2, which is only available online, presents the proposed specifications, commentaries, and example problems for the retaining walls, slopes and embankments, and buried structures.

Mechanics and Design

The Design of Highway Bridges of Steel, Timber and Concrete

Mid-Coast Corridor Transit Project, San Diego, California: Draft Supplemental Environmental Impact Statement: Report

BOX CULVERT (5,5 M X 5,4 M) X 4,5 M

Investigation of an Under-reinforced Concrete Box Culvert Specimen Proportioned According to Limit Design Principles

TRB¿s National Cooperative Highway Research Program (NCHRP) Report 619: Modernize and Upgrade CANDE for Analysis and LRFD Design of Buried Structures explores the development, modernization, and upgrading of the CANDE (Culvert ANalysis and DEsign) program to a new program called CANDE-2007. The CANDE-2007 installation files are included on a CD-ROM with this report. The installed program includes integrated help files and 14 tutorial examples.

Cost-effective Concrete Box-culvert Design

Criteria for Structural Design and Installation

A Symposium Presented at the Seventy-ninth Annual Meeting American Society for Testing and Materials, Chicago, Ill., 27 June-2 July, 1976

Reinforced Concrete Pipe Culverts

The Manual for Bridge Evaluation

Design Automation for Box Culverts Using Web Based Application

"The main purpose of this project is to design a one-piece reinforced concrete box culvert and to establish whether it is a viable alternative to the two-piece design currently being used and produced by the Roads Corporation. The design of the one-piece box culvert is in accordance with the specifications produced by the National Association of the Australian State Road Authorities (NAASRA) 1976, Road Design Manual 1985, the Australian Standards for Concrete Structures (AS3600) 1988, and finally in accordance with VIC ROADS (Roads Corporation) own design specifications. Conclusions were based upon the overall design of the one-piece box culvert taking into account, its configuration (i.e. wall thicknesses, reinforcement layout), the formwork's suitability for repetitive use, and in general, the work associated with such a culvert design during the manufacturing, and installation stages. These factors will then be compared to those associated with the current two-piece box culvert process, to determine whether in fact, the one-piece is a viable alternative based upon these economic and ergonomic factors. " -- Synopsis.

This is a study of the analysis and design of reinforced concrete box culverts (RCB), commonly used as underground conduits in Nebraska. Three major areas were emphasized: 1) soil pressures, 2) live loads and, 3) design procedures.

One Piece Reinforced Concrete Box Culvert Design

Concrete Pipe and Box Culvert Installation

Hydraulic Charts for the Selection of Highway Culverts

Current Practice of Reinforced Concrete Box Culvert Design

Handbook of Concrete Culvert Pipe Hydraulics

Design and check of reinforced concrete box culverts rectangular, single cell, enabling crossing below roads and drainage works. The analysis model used is that of a thick three dimesnional triangular finte element type mesh, which considers deformation due to shear. They are made up of six nodes, at the vertices and mid-points of the sides, each with six degrees of freedom. A mesh is applied on the culvert, the spacing of which depending on its dimensions (thicknesses and spans). By means of a linear elastic analysis, eight forces are obtained for each node which are used to check and design the concrete section and reinforcement. As well as the displacements other checks that are carried out include, deflection, ground bearing pressures, possible mat foundation uplift, etc.

Corrosion-resistant, electromagnetic transparent and lightweight fiber-reinforced polymers (FRPs) are accepted as valid alternatives to steel in concrete reinforcement. Reinforced Concrete with FRP Bars: Mechanics and Design, a technical guide based on the authors’ more than 30 years of collective experience, provides principles, algorithms, and practical examples. Well-illustrated with case studies on flexural and column-type members, the book covers internal, non-prestressed FRP reinforcement. It assumes some familiarity with reinforced concrete, and excludes prestressing and near-surface mounted reinforcement applications. The text discusses FRP materials properties, and addresses testing and quality control, durability, and serviceability. It provides a historical overview, and emphasizes the ACI technical literature along with other research worldwide. Includes an explanation of the key physical mechanical properties of FRP bars and their production methods Provides algorithms that govern design and detailing, including a new formulation for the use of FRP bars in columns Offers a justification for the development of strength reduction factors based on reliability considerations Uses a two –story building solved in Mathcad® that can become a template for real projects This book is mainly intended for practitioners and focuses on the fundamentals of performance and design of concrete members with FRP reinforcement and reinforcement detailing. Graduate students and researchers can use it as a valuable resource. Antonio Nanni is a professor at the University of Miami and the University of Naples Federico II. Antonio De Luca and Hany Zadeh are consultant design engineers.

Development of Design Criteria for Reinforced Concrete Box Culverts

Assessment and Rehabilitation of Existing Culverts

Evaluation of degradation of concrete box culverts and 3-sided culverts. Task 2

Engineers˙pocketbook of Reinforced Concrete

Cost-effective Concrete Box Culvert Design

One of the fast and economical ways of putting tunnels or stream crossings under roadways is to use box culverts. Box culverts are structurally rigid, easy to construct, and easy to add length when needed. Because of their simple geometric configuration, precast concrete box culverts with various dimensions are commonly used in the U.S. In some cases, non-standard box culverts are also used, for which the design document has to be produced per project design specification. The design process of box culverts is relatively easy and repetitive because of their typical geometric configuration. In practice, engineers are following exactly the same process with different dimensions and loading conditions to design box culverts. Microsoft Excel spreadsheet is therefore often used to speed up this repetitive calculation process. In India, many designers use STAAD.Pro for the structural analysis of box culverts and bring the results of this analysis to a Microsoft Excel spreadsheet to carry out the remaining calculations. However, all these cases are dealt separately and a significant amount of time is used to come up with the final design. In addition, it has been challenging to keep all engineering calculations and drawings of a specific box culvert for its lifecycle. One of the solutions that one can come up with for this challenge is to automate the entire design process in one package and keep all design documents in one location. This study presents the Web-based application we developed to 1) automate the box culvert design process and 2) keep all design documents in one location. This Web-based application is developed based on Indian Standard codes (IS) and Indian road congress codes (IRC) using ASP.net. This study presents how this application was developed, how it is working, and how it improved the design process of box culverts in our tests. This study shows that results obtained from this application are very close to the traditional design process and can be successfully used for designing of box culverts in India. Also the study concludes that there is a significant amount of time saving in the design process when this application is used instead of traditional design process. The electronic version of this dissertation is accessible from http://hdl.handle.net/1969.1/155015

Fibre reinforced plastics are increasingly being used as replacements for steel reinforcement in concrete structures. The reinforcement can be untensioned, or it can be in the form of prestressing tendons. It is also suitable for gluing onto the outside of a structure to improve flexural or shear performance. This book provides up-to-date research results to give engineers confidence in their design methods.

Standard Practice for Direct Design of Buried Precast Concrete Pipe Using Standard Installations (SIDD)

BOXCAR, Version 1.0

Cost-effective Concrete Box-culvert Design

Eurocode 2, Système Bt (CPC Fascicule 61, Titre II), REINFORCEMENT, PROJECT DRAWINGS, TAKE Off, DESIGN and CHECK of REINFORCED CONCRETE BOX CULVERTS

FRPRCS-5